PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference VM7031426002	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US04/28756	International filing date (*day/month/year*) 03 September 2004 (03.09.2004)	(Earliest) Priority Date (*day/month/year*) 05 September 2003 (05.09.2003)
Applicant VARIAN MEDICAL SYSTEMS TECHNOLOGIES, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 9 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the Report**
   a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
      ☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
   b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. ☐ **Certain claims were found unsearchable** (See Box No. II)
3. ☐ **Unity of invention is lacking** (See Box No. III)
4. With regard to the **title**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   ☒ the text is approved as submitted by the applicant.
   ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,
   a. the figure of the drawings to be published with the abstract is Figure No. 1
      ☐ as suggested by the applicant.
      ☐ as selected by this Authority, because the applicant failed to suggest a figure.
      ☒ as selected by this Authority, because this figure better characterizes the invention.
   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US04/28756

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G06K 9/00
US CL : 382/128-134; 378/08, 65, 95
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 382/128-134; 378/08, 65, 95

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 3,952,201 A (HOUNSFIELD) 20 April 1976 , column 1, lines 53-68; column 2, lines 1-5; column 3, line 66 through column 4, line 11.	1,2,23,31,32,40,50 and 53. ——— 3-12,13-17, 26-30,35-39,41-45,48-49,51,52, 54-56
Y	US 5,271,055 A (HSIEH et al) 14 December 1993, column 7, lines 10-20.	3-12, 13-17, 26-30,35-39,41-45,48-49, 51, 52,54-56.

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
15 February 2005 (15.02.2005)

Date of mailing of the international search report
15 MAR 2005

Name and mailing address of the ISA/US
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Form PCT/ISA/210 (second sheet) (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

	Date of mailing (*day/month/year*) 15 MAR 2005
Applicant's or agent's file reference VM7031426002	FOR FURTHER ACTION See paragraph 2 below

International application No.	International filing date (*day/month/year*)	Priority date (*day/month/year*)
PCT/US04/28756	03 September 2004 (03.09.2004)	05 September 2003 (05.09.2003)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): G06K 9/00 and US Cl.: 382/128- 134; 378/08,65,95

Applicant

VARIAN MEDICAL SYSTEMS TECHNOLOGIES, INC.

1. This opinion contains indications relating to the following items:

- [X] Box No. I — Basis of the opinion
- [ ] Box No. II — Priority
- [ ] Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV — Lack of unity of invention
- [X] Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI — Certain documents cited
- [ ] Box No. VII — Certain defects in the international application
- [ ] Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(*b*) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

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Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language ____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ in written format

☐ in computer readable form

c. time of filing/furnishing

☐ contained in international application as filed.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US04/28756

Box No. V Reasoned statement under Rule 43 *bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 3-20,26-30,35-39,41-49,51,52 and 54-56	YES
	Claims 1,2,22,23,31,32,40,50 and 53	NO
Inventive step (IS)	Claims 18-20, 46-47	YES
	Claims 1-17,21,22-39, 40- 45, 48 and 49, 50-56	NO
Industrial applicability (IA)	Claims 1-56	YES
	Claims NONE	NO

2. Citations and explanations:

Please See Continuation Sheet

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
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Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

Claims 1, 2, 22, 23, 31, 32, 40, 50 and 53 lack novelty under PCT Article 33(2) as being anticipated by Hounsfield (US.3,952,201).

As to claims 1 22, 31, 40, 50, 53, Hounsfield discloses a method of determining a position of a target region in a medical procedure (abstract, column line 25 - 33), comprising:

acquiring an input image of a target region (note, acquiring image based on radiation source such as X- or Y radiation by monitoring the motion of the heart body by producing motion signal (column 1, lines 53- 68, column 2, lines 1-5);

enhancing a feature of the input image (note, CT scanner comprising an X-ray source 2 and detectors 6 mounting on a rotating gantry 7 drive by motor 8, e.c.g. monitors 10 and speed control 12 for adjusting the two starts in the heart cycle that case gating the source on and off are movement above the designated threshold and movement below the threshold of the beginning and ending of specific phases of the movement, column 3, line 66 through column 4, line 11 describe an embodiment in which image data is correlated with motion data so as to selector the image data that falls within prescribed regions of the cardiac cycle);

registering the input image with a template (column 2, lines 40-68, column 3, lines 1-49, column 3, line 62 through column 4, line 11); and

determining a position of the target region in the input image based on the registering (note, fig 2 an electrocardiogram (e.c.g.) monitors 10 and speed control 12 for adjusting the two starts in the heart cycle that case gating the source on and off are movement above the designated threshold and movement below the threshold of the beginning and ending of specific phases of the movement, column 3, line 6 through column 4, line 11).

As to claims 2, 23 and 32 Hounsfield discloses the method, wherein the enhancing comprises determining a composite image of previously acquired input images (column 3, lines 35- 49).

Claims 3 -6, 13 -17, 26- 30, 35- 39, 41- 45, 48-49, 51, 52, 54-56 lack inventive step under PCT Article 33(3) as being unpatentable over Hounsfield (US.3,952,201) in view of Hsieh et al., (US.5,271,055).

Regarding claim 3, Hounsfield discloses a method of examining a living body by means of penetrating radiation, such as X- or gamma, radiation, and monitoring the motion of the heart of said body and providing motion signals indicative of said motion. Hounsfield is silent about determining a composite image comprises performing an image averaging on the previously acquired input images.

Hsieh discloses methods for reducing motion induced artifacts in a projection imaging system. The system comprises of :

determining a composite image comprises performing an image averaging on the previously acquired input images (column 7, lines 10- 20).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hounsfield to include determining a composite image comprises performing an image averaging on the previously acquired input images. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Hounsfield by the teaching of Hsieh in order to provide a prediction technique in which aberrations in the physiological activity will have minimal effect on accuracy of the predication (as suggested by Hsieh at column 3, lines 28- 30).

WRITTEN OPINION OF THE
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International application No.
PCT/US04/28756

Supplemental Box
In case the space in any of the preceding boxes is not sufficient.

As to claim 4, Hsieh discloses the method , wherein the enhancing further comprises subtracting the composite image from the input image (column 8, lines 21- 37).
As to claim 5, Hsieh discloses the method , wherein the image averaging is performed using a boxcar averaging technique (column 7, lines 10- 20).
As to claim 6, Hsieh discloses the method , wherein the image averaging is performed based on a weighted average (column 7, lines 1-20).
As to claims 7, 24 and 33 Hsieh discloses the method, further comprising selecting the template from a plurality of templates (column 8, lines 20- 59).
As to claims 8, 25 and 34 Hsieh discloses the method, wherein the selecting comprises choosing a template from the plurality of templates that best matches at least a portion of the input image(column 8, lines 20- 59).
As to claim 9, Hsieh discloses the method , wherein the selecting comprises:
comparing the input image with at least a subset of the templates (fig 4B); and
selecting the template that best matches at least a portion of the input image(column 8, lines 21- 41)
As to claim 10, Hsieh discloses the method , wherein the selecting comprises comparing the input image with the template that is generated at approximately a same time-point or a same phase of a physiological cycle as the input image (abstract, column 2, lines 45- 68, column 3, lines 1- 30).
As to claim 12, Hsieh discloses the method , wherein the determining a position of the target region comprises determining a position of the image in the input image that best matches the template (abstract, column 2, lines 45- 68, column 3, lines 1- 30).
As to claims 13, 26, 35 and 48, Hounsfield discloses the method, wherein the input image comprises a fluoroscopic image (note an instrument used for observing the internal structural of the living body by means of X-rays, corresponds to fluoroscopic image, column 1, lines 53 - 68, column 2, lines 1-2).
As to claims 14, 27 and 36, Hounsfield discloses the method, further comprising performing a medical procedure based on the determined position of the target region (note, target region corresponds to monitoring the motion of the heart and providing motion signals indicative of motion, column 2, lines 3 - 8).
As to claims 15, 28 and 37, Hounsfield discloses the method, wherein the medical procedure comprises directing a radiation beam to an object (note, detecting the radiation emergent from the body region corresponds to monitoring the motion of the heart and providing motion signals indicative of motion, column 2, lines 3 - 19).
As to claims 16, 29 and 38, Hounsfield discloses the method, wherein the performing the medical procedure comprises changing a direction of a radiation beam in response to the determined position (column 3, lines 35- 49).
As to claims 17, 30 and 39, Hounsfield discloses the method, wherein the performing the medical procedure comprises gating a delivery of the radiation beam in response to the determined position (note, CT scanner comprising an X-ray source 2 and detectors 6 mounting on a rotating gantry 7 drive by motor 8, e.c.g. monitors 10 and speed control 12 for adjusting the two starts in the heart cycle that case gating the source on and off are movement above the designated threshold and movement below the threshold of the beginning and ending of specific phases of the movement, column 3, line 66 through column 4, line 11).
As to claims 41, 51, 54 and 55, Hsieh discloses the method, further comprising determining a first value associated with a contrast (column 1, lines 13-38, 57- 66, column 4, lines 11-25) of the first difference image (column 1, lines 13-38, 57- 66, column 4, lines 11-25, 52 through column 5, line 68, column 8, lines 20 - 41).
As to claim 42, Hsieh discloses the method, wherein the determining whether the object has moved is performed based on the first value (column 4, line 52 through column 5, line 68).
As to claim 43, Hsieh discloses the method, further comprising:
acquiring a second image of the object (fig 4A, column 5, lines 12- 68);
determining a composite image based on the second image and the reference image (column 6, lines 4- 59); and
determining whether the object has moved based at least on the second
composite image (fig 4B, column 5, lines 57- 68).
As to claim 44, Hsieh discloses the method , further comprising determining a second value associated with a contrast of the second composite image (abstract, column 8, lines10-68).
As to claim 45, Hsieh discloses the method, wherein the determining whether the object has moved is performed based on the second value (column 8, lines 10-68).
As to claims 49, 52 and 56 Hounsfield discloses the method, further comprising enhancing a moving object in the first image (note, CT scanner comprising an X-ray source 2 and detectors 6 mounting on a rotating gantry 7 drive by motor 8, e.c.g. monitors 10 and speed control 12 for adjusting the two starts in the heart cycle that case gating the source on and off are movement above the designated threshold and movement below the threshold of the beginning and ending of specific phases of the movement, column 3, line 66 through column 4, line 11).
Claims 18-20 and 46 - 47 meet the criteria set out in PCT Article 33(2)(4), because the prior art does not teach or fairly suggest the limitation wherein the target region comprises at least a part of an animal body, a lung tissue or a heart tissue and comprises a bone.